## REMARKS

Claims 1-2, 3-7, 12-15 and 17-36 are pending in this application. Claims 3, 8-11 and 16 have previously been canceled without prejudice or disclaimer. For purposes of expedition, independent claims 1, 7, 15, 17, 22, 24 and 27 have been amended to restate the "accuracy of one pixel unit", as already defined during the alignment of the "first image" and the "second image", in order to clearly distinguish over the cited prior art, including Lee, U.S. Patent No. 5,808,735 and Maeda et al, U.S. Patent No. 5,153,444. Since independent claims 1, 7, 15, 17, 22, 24 and 27, as amended, do **not** contain new limitation or raise new issue, entry of the foregoing amendments is proper under 37 C.F.R. §1.116(b) because those amendments simply respond to the issues raised in the final rejection, no further search is required, and the foregoing amendments are believed to remove the basis of the outstanding rejections and to place all claims in condition for allowance.

Claims 1, 4, 5, 22 and 23 have been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of newly cited art, Maeda et al., U.S. Patent No. 5,153,444 for reasons stated on pages 2-4 of the final Office Action (Paper No. 25). In support of this rejection, the Examiner asserts that Lee '735, as a primary reference, discloses all aspects of Applicants' base claims 1 and 22 and their respective dependent claims 4, 5 and 23, except for the alignment of the two images with an accuracy of one pixel. However, the Examiner cites column 4, lines 22-33 of Maeda '444 for allegedly disclosing "a conventional alignment of two images ("the aligned two patterns" at column 4, line 22) with an accuracy of one pixel unit ("pixel-wise alignment" at column 4, line 33; "shifted one pixel at a time" at column 4, line 37").

However, the Examiner's assertion is factually incorrect. As a result, Applicants respectfully traverse the rejection for reasons as discussed herein below.

As previously discussed, Applicants' disclosed invention is characterized in that a defect of the patterns is detected after performing the following two steps as to first and second images, as shown in FIG. 7 (in which a pixel alignment 11 is used to align the two images within one pixel unit before brightness coincidence filtering 12 and local gradation conversion 13) and FIG. 8 (in which a pixel alignment 11 is used to align the two images within one pixel unit after local gradation conversion 13 but before brightness coincidence filtering 12). These two steps include:

(1) Aligning the first and second images with an accuracy of one pixel unit.

(2) Adjusting brightness of at least one of the first and second images to match a brightness of the two images.

For example, Applicants' base claim 1, as amended, defines a method of inspecting patterns, comprising the steps of:

> picking up a first pattern formed on a substrate to produce a first image;
> storing the first image;
> picking up a second pattern that is also formed on the substrate so as to have naturally the same shape as the first pattern, thereby producing a second image;
> aligning the first image and the second image with **an accuracy of one pixel unit**;
> after the first image and the second image are aligned with an accuracy of one pixel unit, **adjusting a brightness of at least one of the first image and the second image to match a brightness of the first image with a brightness of the second image for each pixel**; and
> comparing the first and second images aligned and matched in brightness to detect a defect of the patterns.

Likewise, base claim 22 defines an apparatus for inspecting defects of a plurality of patterns formed on a substrate so as to have naturally the same shape, comprising:

> table means on which the substrate is placed, and which can be moved in an X-Y plane;
> image pick-up means for picking up the patterns of the substrate placed on the table means to produce images of the patterns;
> proposed-defects extracting means for processing the images of the patterns when the substrate placed on the table means is continuously moved, after the images of the patterns have been aligned with **an accuracy of one pixel unit**, and at least one of the images of the patterns has been subjected to gradation conversion to match a brightness of the at least one of the images with a brightness of at least one other one of the images for each pixel of the images, thereby extracting proposed defects of the patterns;
> defect detection means for detecting true defects from the proposed defects of the patterns that have been extracted by the proposed-defects extraction means; and
> output means for producing information of the true defects detected by the defect detection means.

As expressly defined in Applicants' base claims 1 and 22 (relate to, for example, FIG. 7, FIG. 24, FIG. 26, FIG. 28, FIG. 38 and FIG. 42), after the first and second images are aligned with an accuracy of one pixel unit, as shown in FIG. 7, a brightness of at least one of the first image and the second image is adjusted so that a brightness of the first image is matched with a brightness of the second image for each pixel.

In contrast to Applicants' base claims 1 and 22, Lee '735, as a primary reference, discloses a completely different automatic defect classification (ADC) method and system, as shown in FIG. 1, for detecting defects on a test surface of a semiconductor wafer. As shown in FIG. 2A and FIG. 2B, the test image and the reference image are aligned in the x-y plan, and then the test image and the reference image are subtracted from one another in order to determine the presence

of a defect. Specifically, as described on column 5, lines 54-67 and column 7, lines 3-9 of Lee '735, if the intensity difference between the corresponding test and reference pixels exceed an intensity-error threshold value, then such a test-image pixel can be identified as a potential defect pixel that needs to be correct.

Lee '735, as identified by the Examiner, does **not** disclose key features of Applicants' base claims 1 and 22, including "aligning the first image and the second image with an accuracy of one pixel unit" and then "after the first image and the second image are aligned with one pixel unit, adjusting a brightness of at least one of the first image and the second image to match a brightness of the first image with a brightness of the second image for each pixel".

As a newly cited secondary reference, Maeda '444 (also assigned to the same assignee, Hitachi Ltd.,) does **not** remedy the noted deficiencies of Lee '735 in order to arrive at the subject matter of Applicants' base claims 1 and 22. Specifically, Maeda '144 does **not** discloses what the Examiner has characterized as that "the first and second images are aligned with accuracy of one pixel unit" and thereafter "a brightness of at least one of the first and second images is adjusted to match a brightness of the two images for each pixel" (see page 12, lines 11-17 of Applicants' specification) so that a defect can be detected as expressly defined in Applicants' base claims 1 and 22.

On page 3 of the final Office Action (Paper No. 25), Maeda '444 is cited for allegedly disclosing "a conventional alignment of two images ("the aligned two patterns" at column 4, line 22) with an accuracy of one pixel unit ("pixel-wise alignment" at column 4, line 33; "shifted one pixel at a time" at column 4, line 37").

However, this citation is misplaced. The purpose of Maeda '44 is to provide a method and an apparatus for pattern recognition and detecting defects in circuit patterns in which the sensitivity of defect detection is automatically adjusted in accordance with the conditions of fabrication of the shapes of the circuit patterns. According to Maeda '444, a gray image signal from each of a plurality of circuit patterns (as objects of inspection) is detected, and a defect as a difference of edge position between two circuit patterns is determined as a result of a comparison between the detected gray image signal of one circuit pattern with the detected gray image signal of another circuit pattern. See Abstract, Summary of the Invention, claim 1 and claim 14 of Maeda '444.

The cited column 4, lines 22-37 of Maeda '444 refers to a specific type of alignment utilized to compare the detected gray image signal of one circuit pattern with the detected gray image signal of another circuit pattern, that is, "pixel-wise alignment". However, the "pixel-wise alignment" does **not** mean that "aligning the first image and the second image [are done] with an accuracy of one pixel unit" as incorrectly assumed by the Examiner. Rather, on column 4, lines 34-42, Maeda '444 specifically describes that the "pixel-wise alignment" is:

> "a state where, having differences between the detected pattern and the stored pattern summed up for pixels all over the area of the image and the **summation performed with the stored pattern shifted one pixel at a time relative to the detected pattern**, the images are brought into a position where the sum total of the differences becomes a minimum, i.e., the two images are best aligned."

In other words, the "pixel-wise alignment" is completely different from "aligning the first image [picked up from a substrate] and the second image [also picked up from a substrate] with an accuracy of one pixel unit" as expressly defined in

Applicants' base claims 1 and 22. More importantly, Maeda '444 does **not** disclose that "the first and second images are aligned with one pixel unit" and thereafter "a brightness of at least one of the first and second images is adjusted to match a brightness of the two images" so that a defect can be detected as expressly defined in Applicants' base claims 1 and 22.

In order to establish a *prima facie* case of obviousness under 35 U.S.C. §103, the Examiner must show that the prior art reference (or references when combined) must teach or suggest all the claim limitations, and that there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skilled in the art, to modify the reference or to combine reference teachings, provided with a reasonable expectation of success. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and **not** based on Applicants' disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). See MPEP 2143. In other words, all the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). In addition, "obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination." ACS Hospital System, Inc v. Montefiore Hospital, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984). The Examiner must point to something in the prior art that suggests in some way a modification of a particular reference or a combination of references in order to arrive at Applicants' claimed invention. Absent such a showing, the Examiner has

improperly used Applicants' disclosure as an instruction book on how to reconstruct to the prior art to arrive at Applicants' claimed invention.

Moreover, any deficiencies of the cited references cannot be remedied by general conclusions about what is "basic knowledge" or "common sense". In re Sang Su Lee, No. 00-1158 (Fed. Cir. 2002).

In the present situation, both Lee '735 and Maeda '444 fail to disclose and suggest key features of Applicants' base claims 1 and 22. Therefore, Applicants respectfully request that the rejection of base claims 1 and 22 and their respective dependent claims 4-5 and 23 be withdrawn.

Even assuming *arguendo* that Maeda '44 disclose what the Examiner alleges, Maeda '444 cannot be incorporated into the automatic defect classification (ADC) method and system of Lee '735 in the manner suggested by the Examiner. This is because the automatic defect classification (ADC) method and system of Lee '735 utilizes a different defect detection scheme based the subtraction between the test image and the reference image relative to an intensity threshold value. If the alignment is altered in the manner suggested by the Examiner, the resultant would utterly defeat the intended purpose advocated by Lee '735. Therefore, in view of the foregoing reasons and deficiencies in the proposed combination of Lee '735 and Maeda '444, whether taken individually or in combination with any other prior art of record, Applicants respectfully request that the rejection of Applicants' base claims 1 and 22 and their respective dependent claims 4-5 and 23 be withdrawn.

Separately, claims 7, 12-15, 18, 21 and 24-29 have been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of newly cited art, Maeda et al., U.S. Patent No. 5,153,444, as applied to claim

22 above, and further in view of Michael, U.S. Patent No. 5,640,200 for reasons stated on pages 4-5 of the final Office Action (Paper No. 25). Applicants respectfully traverse the rejection for the reasons discussed herein below.

First of all, claims 7, 12-15, 18, 21 and 24-29 cannot be rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, and Maeda et al., U.S. Patent No. 5,153,444, as applied to claim 22 as alleged by the Examiner. This is because claims 7, 12-15, 18 and 21 do **not** depend upon base claim 22.

Secondly, each of Applicants' base claims 7, 15 and 27 is clearly distinguishable over the Examiner's proposed combination of Lee et al., U.S. Patent No. 5,808,735, Maeda et al., U.S. Patent No. 5,153,444, and Michael, U.S. Patent No. 5,640,200 for the same reasons discussed above, and for additional reasons as discussed *in seriatim* herein below.

For example, Applicants' base claim 7, as amended, defines a method of inspecting a pattern, comprising the steps of:

> picking up a first pattern formed on a substrate to produce a first image;
> storing the first image;
> picking up a second pattern that is formed on the substrate so as to have naturally the same shape as the first pattern, thereby producing a second image;
> aligning the first image and the second image with an accuracy of one pixel unit;
> after the first image and second image are aligned with an accuracy of one pixel unit, adjusting a brightness of at least one of the first image and the second image by collectively filtering the first image and the second image to match the brightness of the two images;
> performing gradation conversion of at least one of the first image and the second image to match a brightness of the first image with a brightness of the second image for each pixel;
> comparing the first and second images to detect a defect and to obtain features of the detected defect; and

displaying information of the features of the detected defect on a screen.

Likewise, base claim 15, as amended, defines an apparatus for inspecting defects of patterns, comprising:

image pick-up means for picking up a first pattern formed on a substrate and a second pattern that is also formed on the substrate so as to have naturally the same shape as the first pattern, thereby producing a first image of the first pattern and a second image of the second pattern;

storage means for storing the first image;

alignment means for aligning the first image and the second image with an accuracy of one pixel unit;

brightness conversion means for adjusting a brightness of at least one of the first image and the second image by collectively filtering the first and second images to match a brightness of the two images;

gradation conversion means for performing gradation conversion of at least one of the first image and the second image to match a brightness of the first image with a brightness of the second image for each pixel;

defect detection means for comparing the first and second images, at least one of which has a brightness which has been corrected by the gradation conversion means, thereby detecting defects of the patterns; and

output means for producing information of the defects of the patterns detected by the defect detection means.

Alternatively, base claim 27, as amended, defines an apparatus for inspecting defects of patterns, comprising:

image pick-up means for picking up a first pattern formed on a substrate and a second pattern that is formed on the substrate so as to have naturally the same shape as the first pattern, thereby producing a first image of the first pattern and a second image of the second pattern;

storage means for storing the first image;

defect detection means for correcting at least one of the first image and the second image by performing gradation conversion of at least one of the first image and the second image to match a brightness of the first image with a brightness of the second image for each pixel of said first and second images, aligning the first image and the second image with an accuracy of one pixel unit, collectively

filtering the first image and the second image to match a brightness of the first image with a brightness of the second image, comparing the first image and the second image aligned and matched in brightness to detect defects, and then estimating information of the detected defects; and

display means for displaying on a screen the defects detected by the defect detection means, and the information of the detected defects.

As expressly defined in Applicants' base claims 7, 15 (see FIG. 7) and claim 27 (see FIG. 8), after the first and second images are aligned with an accuracy of one pixel unit, as shown in FIG. 7, the brightness adjustment is made as follows:

(1) Adjusting brightness of at least one of the first and second images by collectively filtering the first and second images to match a brightness of the two images for each pixel (All the images are passed through a filter at a time so that the brightness of one image coincides with that of the other, shown in FIG. 7, block 11. Refer to the description from page 11, line 23 to page 12, line 10.).

(2) Performing gradation conversion of at least one of the first and second images to match a brightness of the first image with a brightness of the second image (Adjustment of the brightness is performed for each area smaller than that of the adjustment made above by correcting gain and offset. Refer FIG. 7, block 13).

In contrast to Applicants' base claims 7, 15 and 27, Lee '735, as a primary reference, discloses a completely different automatic defect classification (ADC) method and system, as shown in FIG. 1, for detecting defects on a test surface of a semiconductor wafer. As shown in FIG. 2A and FIG. 2B, the test image and the reference image are aligned in the x-y plan, and then the test image and the reference image are subtracted from one another in order to determine the presence of a defect.

As secondary references, Maeda '444 and Michael '200 do **not** remedy the noted deficiencies of Lee '735 in order to arrive at Applicants' base claims 7, 15 and 27. This is simply because Maeda '444 only discloses a method and an apparatus for pattern recognition and detecting defects in circuit patterns in which the sensitivity of defect detection is automatically adjusted in accordance with the conditions of fabrication of the shapes of the circuit patterns, and Michael '200 only discloses a golden template comparison (GTC) method applied to flaw and defect detection in images of two-dimensional scenes.

On page 5 of the final Office Action (Paper No. 25), the Examiner asserts that Michael '200 discloses a local contrast normalization which comprises a brightness filter means ("filter" at column 14, line 36) for adjusting a brightness of one of the aligned images by filtering all images of the patterns to match a brightness of the images (equation "6", at column 14, line 40)". However, the cited portion of Michael '200 merely discloses "local contrast normalization". Michael '200 does **not** disclose what size the term "local" indicates and **not** disclose or suggest to correct the brightness of individual pixels for each pixel.

As discussed, Lee '735, Maeda '444 and Michael '200, whether taken individually or in combination, fail to disclose and suggest all key features of Applicants' base claims 7, 15 and 27. Therefore, Applicants respectfully request that the rejection of Applicants' base claims 7, 15 and 27 and their respective dependent claims 12-14, 18, 21 and 25-29 be withdrawn.

Claims 31 and 35 have been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied to claims 1 and 22 above, and further in view

of Teo, U.S. Patent No. 6,128,108 for reasons stated on pages 6-7 of the final Office Action (Paper No. 25). Likewise, dependent claim 2 has been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied to claim 1 above, and further in view of Haskell, U.S. Patent No. 6,111,596 for reasons stated on pages 7-8 of the final Office Action (Paper No. 25). Dependent claim 6 has been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied to claim 1 above, and further in view of Wagner, U.S. Patent No. 5,659,172 for reasons stated on page 9 of the final Office Action (Paper No. 25). Dependent claims 32, 33, 34 and 36 have been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied to claim 7 above, and further in view of Teo '108 for reasons stated on pages 10-11 of the final Office Action (Paper No. 25). Dependent claims 19 and 30 has been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied to claim 1 above, and further in view of Wagner '172 for reasons stated on pages 11-12 of the final Office Action (Paper No. 25). Dependent claim 17 has been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied to claim 15 above, and further in view of Haskell, U.S. Patent No. 6,111,596 for reasons stated on pages 7-8 of the final Office Action (Paper No. 25). Lastly, dependent claim 20 has been rejected under 35 USC 103(a) as being unpatentable over Lee et al., U.S. Patent No. 5,808,735, in view of Maeda et al., U.S. Patent No. 5,153,444, as applied

to claim 15 above, and further in view of Wihl, U.S. Patent No. 4,633,504 for reasons stated on pages 13-14 of the final Office Action (Paper No. 25). Since the correctness of these rejections is predicated upon the correctness of the rejections of Applicants' base claims 1, 7, 15, 22 and 27, Applicants respectfully traverse these rejections for the same reasons discussed against the rejections of Applicants' base claims 1, 7, 15, 22 and 27.

In view of the foregoing amendments, arguments and remarks, all claims are deemed to be allowable and this application is believed to be in condition to be passed to issue. Should any questions remain unresolved, the Examiner is requested to telephone Applicants' attorney at the Washington DC area office at (703) 312-6600.

**INTERVIEW:**

In the interest of expediting prosecution of the present application, Applicants respectfully request that an Examiner interview be scheduled and conducted. In accordance with such interview request, Applicants respectfully request that the Examiner, after review of the present Amendment, contact the undersigned local Washington, D.C. area attorney at the local Washington, D.C. telephone number (703) 312-6600 for scheduling an Examiner interview, or alternatively, refrain from issuing a further action in the above-identified application as the undersigned attorneys will be telephoning the Examiner shortly after the filing date of this Amendment in order to schedule an Examiner interview. Applicants thank the Examiner in advance for such considerations. In the event that this Amendment, in

and of itself, is sufficient to place the application in condition for allowance, no Examiner interview may be necessary.

To the extent necessary, Applicants petition for an extension of time under 37 CFR §1.136. Please charge any shortage of fees due in connection with the filing of this paper, including extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, No. 01-2135 (Application No. 500.37149X00), and please credit any excess fees to said deposit account.

Respectfully submitted,

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